

TURCK

Your Global Automation Partner

B...N...-QR20-2UPN... Inclinometer with Switching Outputs

Instructions for Use

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1 About these instructions

These instructions describe the setup, functions and use of the product and help you to operate the product according to its intended purpose. Read these instructions carefully before using the product. This will prevent the risk of personal injury and damage to property. Keep these instructions safe during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed at qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Explanation of symbols

The following symbols are used in these instructions:



DANGER

DANGER indicates a hazardous situation with a high level of risk, which, if not avoided, will result in death or serious injury.



WARNING

WARNING indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in death or serious injury.



CAUTION

CAUTION indicates a hazardous situation with a medium level of risk, which, if not avoided, will result in moderate or minor injury.



NOTICE

CAUTION indicates a situation which, if not avoided, may cause damage to property.



NOTE

NOTE indicates tips, recommendations and important information about special action steps and issues. The notes simplify your work and help you to avoid additional work.



MANDATORY ACTION

This symbol denotes actions that the user must carry out.



RESULT OF ACTION

This symbol denotes the relevant results of an action.

1.3 Other documents

Besides this document, the following material can be found on the Internet at www.turck.com:

- Data sheet
- EU Declaration of Conformity (current version)

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

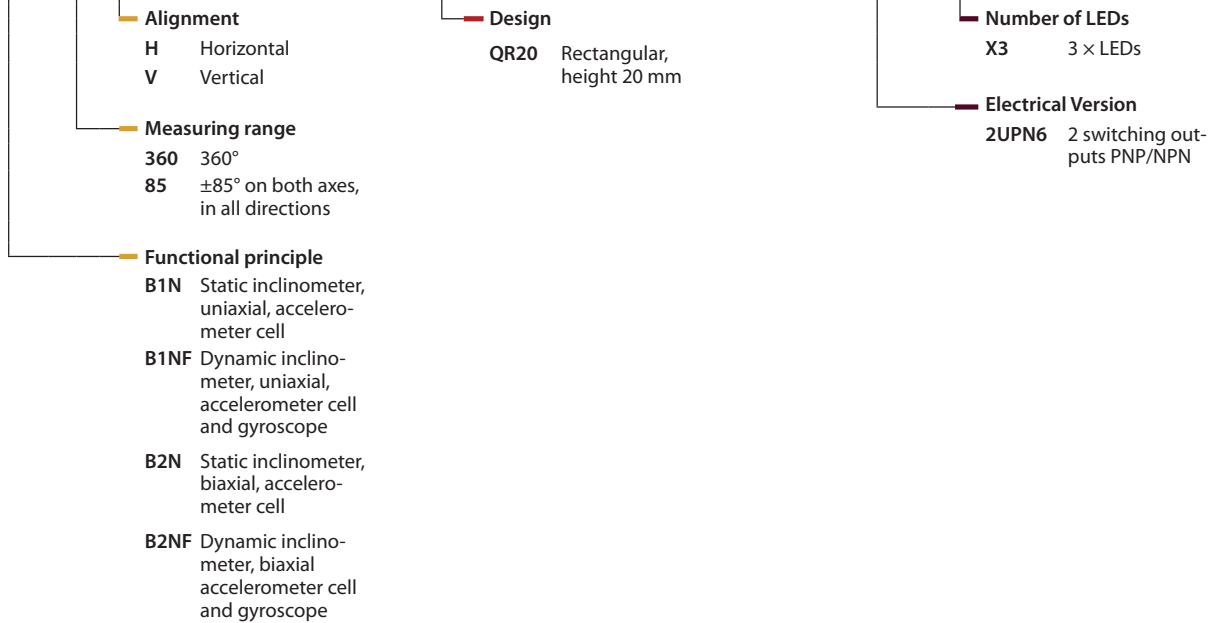
2 Notes on the product

2.1 Product identification

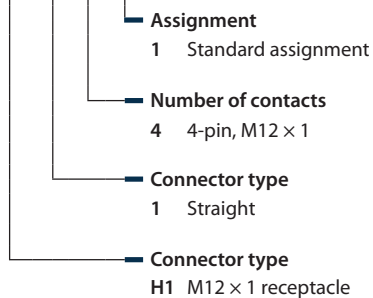
These instructions apply to the following inclinometers:

B1NF 360 V - QR20 - 2UPN6 - H1 1 4 1

B1NF 360 V Functional principle - **QR20** Design - **2UPN6 X3** Electrical version -



H1 1 4 1 Electrical connection



2.2 Scope of delivery

The delivery consists of the following:

- Inclinometer
- Quick Start Guide

2.3 Turck service

Turck supports you in your projects – from the initial analysis right through to the commissioning of your application. The Turck product database at www.turck.com offers you several software tools for programming, configuring or commissioning, as well as data sheets and CAD files in many export formats.

The contact data for Turck branches is provided at [▶ 23].

3 For your safety

The product is designed according to state of the art technology. Residual hazards, however, still exist. Observe the following safety instructions and warnings in order to prevent danger to persons and property. Turck accepts no liability for damage caused by failure to observe these safety instructions.

3.1 Intended use

The inclinometers of the B...N...-QR20-2UPN... series determine the inclination angle. The device indicates via the status of the switching outputs whether the measured angle of inclination is located within the switch window. The switch window can be parameterized as required.

The device must only be used as described in these instructions. Any other use is not in accordance with the intended use. Turck accepts no liability for any resulting damage.

3.2 Obvious misuse

- The devices are not safety components and must not be used for personal or property protection.

3.3 General safety instructions

- The device meets the EMC requirements for the industrial areas. When used in residential areas, take measures to prevent radio frequency interference.
- The device must only be fitted, installed, operated, parameterized and maintained by trained and qualified personnel.
- Only use the device in compliance with the applicable national and international regulations, standards and laws.
- Only operate the device within the limits stated in the technical specifications.

4 Product description

The inclinometers of the B...N...-QR20... series are provided with a 4-pin M12 plug connector for connecting the sensor cable. The housing is made from plastic and is a fully potted and sealed unit with protection to IP68/IP69K. The sensors are protected from temperature fluctuations.

The device functions can be set via an FDT frame (e.g. PACTware).

4.1 Device overview

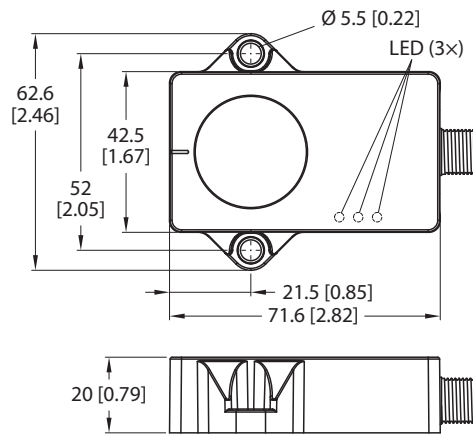


Fig. 1: Dimensions

4.1.1 Indication elements

The devices are provided with one green and two yellow LEDs. The green LED indicates the operating voltage and the device status. The yellow LEDs indicate the switching status of the configurable switching outputs.

The spirit level function can be switched on via an FDT frame to provide assistance during commissioning. The yellow LEDs are lit when the spirit level function is active.

4.2 Properties and features

- Angle measurement (1-axis devices): 0...359.9°
- Angle measurement (2-axis devices): ±85°
- Accelerometer cell
- Degree of protection IP68/IP69K
- Protection against rapid temperature fluctuations
- 10...30 VDC
- Spirit level function (switchable)

The dynamic inclinometers (B...NF...-QR20...) are also provided with the following features:

- Gyroscope sensor

4.3 Operating principle

Static inclinometers

The inclinometers use an accelerometer cell for angle measurement and indicate via the switching outputs whether the measured inclination angle is within the freely configurable switch window. The earth's gravity is used as the reference. If the angle in relation to gravity changes, this is detected by the accelerometer cell.

Dynamic inclinometers

The dynamic inclinometers use an accelerometer cell and a gyroscope sensor for angle measurement. The devices indicate via the switching outputs whether the measured inclination angle is within the freely configurable switch window. A fusion algorithm calculates the inclination from the acceleration values and rotation rate values. The fusion algorithm minimizes the effects of vibration and interfering acceleration. The sensor can thus also output a stable signal in dynamic applications.

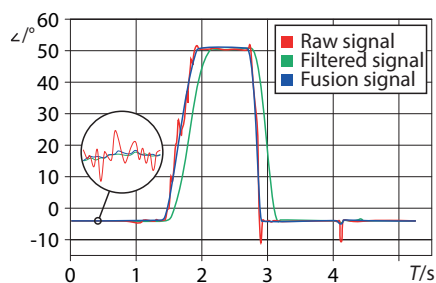


Fig. 2: Fusion algorithm – minimizing interfering acceleration

4.4 Functions and operating modes

The devices are provided with an IO-Link interface and can be set with the USB-2-IOL-0002 IO-Link adapter via an FDT frame (e.g. PACTware).

4.4.1 Measurement axes

The measurement axis of the 1-axis inclinometers covers the angle range from 0...359.9°.

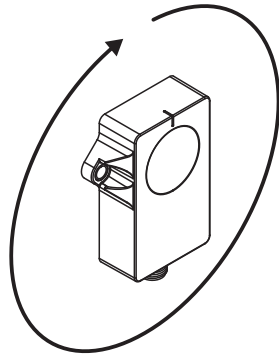


Fig. 3: One measurement axis

The 2-axis inclinometers cover the angle range of $\pm 85^\circ$ on two axes in all directions. This results in an unmeasurable angle of 10° per 180° .

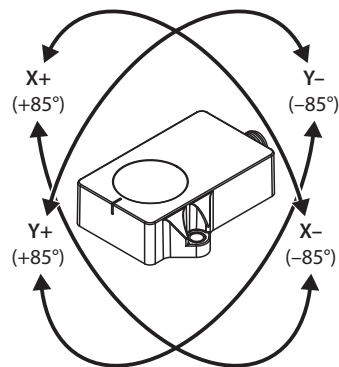


Fig. 4: Two measurement axes

4.4.2 Output function

Window function

A window function can be set for the switching outputs. The window function is used to teach a switching range in which the switching output takes on a defined switching state. The switching range is defined by an upper and lower limit value. The start point of the switch window must be less than the end point of the switch window. The smallest switch window is 1°.

Hysteresis function

The hysteresis function makes it possible to teach in a stable switching state. The switching range is defined with a switching point and a reset point. The hysteresis can be parameterized in 0.1° increments.

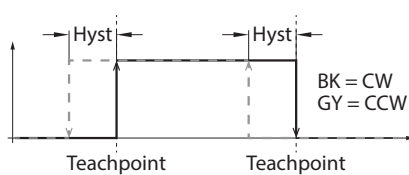
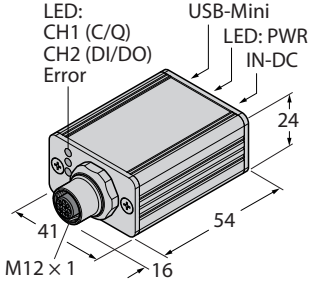
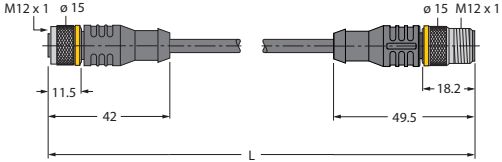
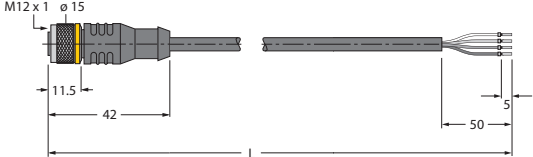


Fig. 5: Hysteresis function

4.5 Technical accessories

Dimension drawing	Type	ID	Description
	USB-2- IOL-0002	6825482	IO-Link adapter V1.1 with integrated USB interface
	RKC4.4T-2- RSC4.4T/TXL	6625608	Connection cable, M12 female connector, straight, 4-pin, M12 male connector, straight, 4-pin, cable length: 2 m, sheathing material: PUR, black; cULus approval; other cable lengths and types available, see www.turck.com
	RKC4.4T-2/ TXL	6625503	Connection cable, M12 female connector, straight, 4-pin, cable length: 2 m, sheathing material: PVC, black; cULus approval; other cable lengths and types available, see www.turck.com

5 Installing

Depending on the sensor type, the sensors can be installed vertically (B1N...V...) or horizontally (B2N...H...).

In order to implement redundant measurement systems, several sensors can be installed next to each other without any gaps. Multiple sensors have no mutual effect on angle measurement. The maximum tightening torque of the screws is 3 Nm.

- ▶ Clean the installation surface and the surrounding area.
- ▶ Position the potted side of the device on an even surface so that the potting compound is covered.
- ▶ Fasten the device with two screws.
- ▶ After the overhead installation of 2-axis sensors: Carry out the center point teach function.

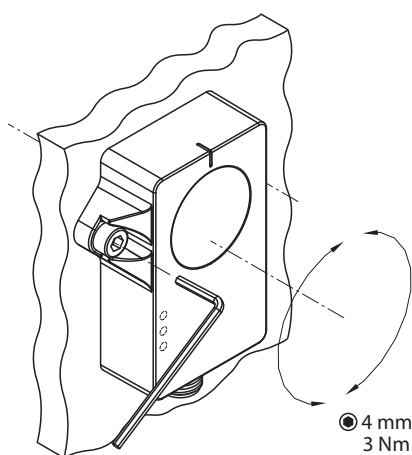


Fig. 6: B1N...V... — vertical installation

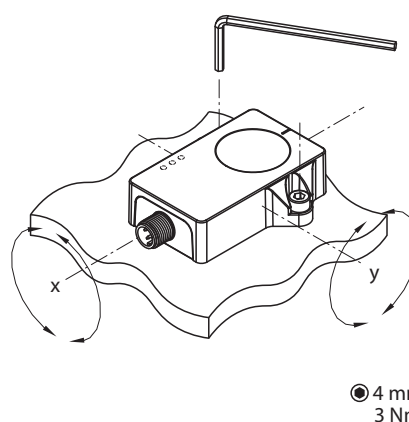


Fig. 7: B2N...H... — horizontal installation

6 Connection

- ▶ Connect the female connector of the connection cable to the male connector of the sensor.
- ▶ Connect the open end of the connection cable to the power supply and/or processing units.

6.1 Wiring diagram

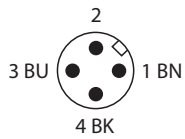


Fig. 8: Pin assignment

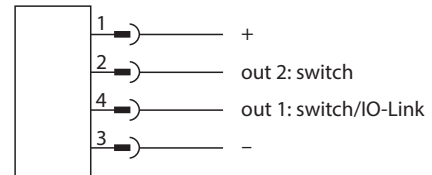


Fig. 9: Wiring diagram

7 Commissioning

After connecting and switching on the power supply, the device is automatically ready for operation.

7.1 Commissioning aid – spirit level

The yellow LEDs act as a spirit level for the alignment of the inclinometer. The two yellow LEDs are lit when the position of the inclinometer is within a window of $\pm 0.5^\circ$ around the center. The LEDs flash at an increasing frequency the closer the sensor approaches the center position.

For 1-axis devices, one LED flashes. For 2-axis devices, both LEDs flash.

The spirit level function can be set via an FDT frame (e.g. PACTware). The function is deactivated by default.

8 Operation

8.1 LED display

LED	Color	Meaning
PWR/IOL	Green	Device is operational
	Green flashing	FDT/IODD communication active
Out 1	Yellow	Out 1 switching state (parametrizable) Default (1-axis): $\pm 3^\circ$ around the zero point (downward outgoing plug connector) active Default (2-axis): $\pm 3^\circ$ around the zero point (plug connector horizontally aligned) active
		Out 2 switching state (parametrizable) Default (1-axis): outside of the switch window around the zero point (downward outgoing plug connector) active Default (2-axis): $\pm 3^\circ$ around the zero point (plug connector horizontally aligned) active

Spirit level function

When the spirit level function is active, the parameterized switching state is not displayed.

LED	Color	Meaning
Out 1/ Out 2	Yellow	Spirit level function – Midpoint reached ($\pm 0.5^\circ$)
Out 2	Yellow flashing (increasing frequency)	Spirit level function – Approaching midpoint
	Yellow flashing (decreasing frequency)	Spirit level function – Moving away from midpoint

9 Setting

9.1 Settable functions and features

Parameters	Meaning
Restore factory setting	The function restores the default state of the device. The device is restarted after the reset. Default setting, 1-axis devices: The downward outgoing plug connector represents the zero point. The switch window is in a range of $\pm 3^\circ$ around the zero point. Out 1 active within this window, and Out 2 is active outside of this window. Default setting, 2-axis devices: The horizontally aligned plug connector represents the zero point. The switch window is in a range of $\pm 3^\circ$ around the zero point. Within this window, one output is active for each measurement axis.
Spirit level	The spirit level function can be deactivated or activated. The function is deactivated by default.
Center position	The function enables the current inclination to be defined as a new measuring range center. On 2-axis devices, the taught measuring range center must not deviate from the physical zero point by more than 30° .
Switching output configuration	The switching outputs can be set for either PNP or NPN operation. PNP is active by default.
Switching outputs	The switching outputs can be set either as NO contacts or as NC contacts. The switch window is set by default to a range of $\pm 3^\circ$ around the zero point. With 1-axis devices one switching output is set by default as an NO contact within this window and one as an NC contact. With 2-axis devices both switching outputs are set by default as NO contacts within this window.
Axis	The measurement axis can be set (2-axis devices).
Start position	The start point of the switch window can be set. The switching window must be $> 1^\circ$.
End position	The end point of the switch window can be set. The switching window must be $> 1^\circ$.
Hysteresis	The window of the hysteresis behavior can be set. The hysteresis must be less than the switching window. The default value is 1° .
Setting the start position	The current inclination angle can be set as the start point of the switch window.
Setting the end position	The current inclination angle can be set as the end point of the switch window.

Parameters	Meaning
Filters	<p>Different filters can be set for static and dynamic inclinometers. A fusion algorithm calculates the inclination from the acceleration values and rotation rate values. The setting for the filter parameters changes significant areas of the fusion algorithm. The individual sensor data items are weighted differently in the various filters. The different weighting of the sensor data can compensate for disadvantages in the measurement process.</p> <p>The slow filter can compensate for fast interfering acceleration in the application. The filter is suitable for applications with slow and precise movements where major external interference may occur. Repetitive, rapid movements can accumulate and distort the filter.</p> <p>Very fast and fast filters provide greater accuracy for rapid movements in the application. The filter can be more easily affected by fast interfering acceleration. Repetitive movements cannot accumulate and distort the filter.</p> <ul style="list-style-type: none">■ Static inclinometers:<ul style="list-style-type: none">– Balanced (factory setting)– Slow■ Dynamic sensors:<ul style="list-style-type: none">– Balanced– Slow– Fast– Very fast (factory setting)

9.2 Setting via FDT/IODD

The devices can be set via a PC with an FDT frame application (e.g. PACTware). All the required Turck software components can be downloaded via the Turck Software Manager:

- PACTware
- IODD
- DTM for USB-2-IOL-002 IO-Link adapter
- IODD DTM Configurator

The Turck Software Manager can be downloaded free of charge from www.turck.com.

The USB-2-IOL-002 USB IO-Link adapter (ID 6825482) is required for connecting to the PC.

A 4-pin standard sensor cable (e.g. RKC4.4T-2- RSC4.4T/TXL, ID 6625608) is required for connecting the sensor to the USB-2-IOL-002 IO-Link adapter.

Further information on setting the devices via IODD with a configuration tool is provided in the IO-Link commissioning manual.

10 Troubleshooting

If the device does not function as expected, first check whether ambient interference is present. If there is no ambient interference present, check the connections of the device for faults.

If there are no faults, there is a device malfunction. In this case, decommission the device and replace it with a new device of the same type.

11 Maintenance

The device is maintenance-free. Clean with a damp cloth if required.

12 Repair

The device is not intended for repair by the user. The device must be decommissioned if it is faulty. Observe our return acceptance conditions when returning the device to Turck.

12.1 Returning devices

If a device has to be returned, bear in mind that only devices with a decontamination declaration will be accepted. This is available for download at <https://www.turck.de/en/return-service-6079.php> and must be completely filled in, and affixed securely and weather-proof to the outside of the packaging.

13 Disposal



The devices must be disposed of properly and do not belong in the domestic waste.

14 Technical data

14.1 Technical data B1N...-QR20-2UPN6X3-H1141

Type	B1N360V-QR20-2UPN6X3-H1141	B1NF360V-QR20-2UPN6X3-H1141
ID	100026933	100026931
Measuring range	359.9°	
Number of measuring axes	1	
Repetition accuracy	≤ 0.05 % of full scale	≤ 0.03 % of full scale
Temperature drift	≤ ± 0.006 %/K	
Ambient temperature	-40...+85 °C	
Temperature changes (EN 60068-2-14)	-40...+85 °C; 20 cycles	
Operating voltage	10...30 VDC	
Ripple	≤ 10 % U _{ss}	
Insulation test voltage	≤ 0.5 kV	
Wire break/ reverse polarity protection	Yes	
Output function	4-pin, NC contact/NO contact, PNP/NPN	
Current consumption	< 50 mA	
Rated operational current	200 mA	
Design	Rectangular, QR20	
Dimensions	71.4 × 62.5 × 20 mm	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 x 1	
Vibration resistance (EN 60068-2-6)	20 g; 5 h/axis; 3 axes	
Shock resistance (EN 60068-2-27)	150 g; 4 ms ½, sinusoidal	200 g; 4 ms ½, sinusoidal
Protection type	IP68/IP69K	
MTTF	548 years acc. to SN 29500 (Ed. 99) 40 °C	
Operating voltage indication	1 × LED, green	
Measuring range indication	2 × LED, yellow	

14.2 Technical data B2N...-QR20-2UPN6X3-H1141

Type	B2N85H-QR20-2UPN6X3-H1141	B2NF85H-QR20-2UPN6X3-H1141
ID	100026934	100026932
Measuring range	±85°	
Number of measuring axes	2	
Repetition accuracy	≤ 0.1 % of full scale	≤ 0.06 % of full scale
Temperature drift	≤ ± 0.012 %/K	
Ambient temperature	-40...+85 °C	
Temperature changes (EN 60068-2-14)	-40...+85 °C; 20 cycles	
Operating voltage	10...30 VDC	
Ripple	≤ 10 % U _{ss}	
Insulation test voltage	≤ 0.5 kV	
Wire break/ reverse polarity protection	Yes	
Output function	4-pin, NC contact/NO contact, PNP/NPN	
Current consumption	< 50 mA	
Rated operational current	200 mA	
Design	Rectangular, QR20	
Dimensions	71.4 × 62.5 × 20 mm	
Housing material	Plastic, Ultem	
Electrical connection	Male connector, M12 x 1	
Vibration resistance (EN 600068-2-6)	20 g; 5 h/axis; 3 axes	
Shock resistance (EN 60068-2-27)	150 g; 4 ms ½, sinusoidal	200 g; 4 ms ½, sinusoidal
Protection type	IP68/IP69K	
MTTF	548 years acc. to SN 29500 (Ed. 99) 40 °C	
Operating voltage indication	1 × LED, green	
Measuring range indication	2 × LED, yellow	

15 Turck branches — contact data

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Brazil	Turck do Brasil Automação Ltda. Rua Anjo Custódio Nr. 42, Jardim Anália Franco, CEP 03358-040 São Paulo www.turck.com.br
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